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Dated

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26 FEB 1998 2341033-14 002833

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Cardiff Road
Newport
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1. Your reference AJM/6806

26 FEB 1998

9803927.4

2. Patent application number
(The Patent Office will fill in this part)

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Fenland Laundries Limited
Roman Bank, Skegness, Lincolnshire, PE25 1SQ.

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

Dissipation of Static Electricity in Workwear

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Loven + Co
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Swindell & Pearson
48 Friar Gate,
Derby DE1 1GY

Patents ADP number (if you know it)

4467460003

00004578004

FS17 18/1/98

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Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
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Patents Form 1/77

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Continuation sheets of this form

Description

12

Claim(s)

Abstract

Drawing(s)

7 only

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Swindell & Pearson

Date 25/2/98

Swindell & Pearson

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr. A.J. MacMaster - 01332 367051

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DISSIPATION OF STATIC ELECTRICITY IN WORKWEAR

This invention relates to a method and means for dissipating static electricity and is especially, but not exclusively, applicable to specialised workwear.

As electronic components become smaller and more sensitive they may be easily damaged by static electrical charges. It is therefore important that operatives engaged in the manufacture of such components are at earth potential, that is they do not carry a static electrical charge. For this purpose specialised garments for use in the micro electronics industry have been developed which are made from tightly woven fabric incorporating a grid or stripe of electrically conductive yarn. This is designed to dissipate static electrical charges which would otherwise build-up as the garment is worn. In particularly sensitive situations static dissipation is improved by earthing the operator, the garment or both.

Difficulties can arise in relation to such garments due to the fact that the conductive filaments are woven into the fabric and as such come to the surface of the fabric relatively infrequently and in an erratic manner. As a result if one piece of fabric is placed on top of another, as occurs, for example in the case of a seam between adjacent parts of a garment, the electrically conductive filaments in each piece of fabric are unlikely to make contact or satisfactory contact with one another with the result that it is unlikely a satisfactory electrical connection will be made across the seam. A similar problem arises in the case of articles of workwear consisting of more than one garment, for example where a hood or an item of footwear are used in association with a main garment. As a result it is difficult to satisfactorily earth an entire garment from a single earthing point.

According to the present invention there is provided a method of forming an electrical connection between adjacent components of an article, such as an article of workwear, at least one of which components incorporates a

plurality of electrically conductive fibres, the method comprising bridging a plurality of said fibres by an electrically conductive member a portion of which is adapted for connection to the adjacent component of the article whereby to form an electrical connection between the conductive fibres of said first component and the second component.

Preferably the article is an article of workwear, said component which incorporates said electrically conductive fibres being of woven construction.

The term "component" is used herein to refer both to adjacent components of a single article of workwear and adjacent garments or other items which together form a complete article of workwear. A single article may, for example, be formed from a number of panels connected together by seams, each of the panels comprising a component of the complete article. Alternatively an item of workwear may consist of a number of separate articles which are worn together such as a body garment, a hood and articles of footwear, each of which comprises a component of the overall article.

Thus the invention also provides an article of workwear comprising a plurality of components at least one of which incorporates electrically conductive fibres, and an electrically conductive member bridging the junction between adjacent components and in electrically conducting relationship with a portion of each component, whereby to electrically interconnect the components.

Where the article of workwear comprises a single garment, the components may comprise adjacent panels from which the garment is constructed and which are connected to one another by seams. In such cases said electrically conductive member may extend across each of the seams of the article so as to bridge the seam and interconnect electrically conductive members incorporated in the respective panels. Alternatively the electrically conductive member may be incorporated in the seam in surface contact with

each of the panels connected together at the seam.

Where the components comprise a plurality of separate garments employed together to form a complete article of workwear, said electrically conductive member may incorporate fastening means adapted for engagement with complimentary fastening means on an adjacent article, the respective fastening means being associated with respective electrically conducting members bridging a plurality of conductive fibres incorporated in each of the articles. The articles may comprise an upper body or jacket portion of a garment and a lower body or trouser portion. Alternatively, or in addition, the articles may comprise a hood together with an upper body portion or a unitary upper and lower body portion of a garment. In either case the lower body portion of the garment may incorporate integral or separate articles of footwear.

Alternatively the articles may comprise a complete body garment or a lower body garment and associated articles of footwear, said electrically conductive member extending across the junction of one article to the other and being connected to or juxtaposed with one or both of the articles.

Alternatively an electrically conductive member may be associated with each article, the electrically conductive members incorporating complementary fastening members adapted for engagement with one another to secure the articles together and form an electrically conducting path between them. The complementary fastening members may comprise components of a press or stud fastener.

In an alternative arrangement said electrically conductive member may comprise a stirrup, opposite ends of which are secured to lower edge regions of leg portions of a garment, the stirrup being adapted to extend beneath the wearer's foot in contact with an article of footwear having a conductive sole. The stirrup member may be located around the wearer's foot internally of the article of footwear whereby to be compressed in use between the wearer's foot and the inner surface of the conductive sole of the article of footwear.

Alternatively the stirrup member may be arranged to extend around the outer surface of an article of footwear whereby to be compressed in use between the outer surface of the conductive sole of the article of footwear and the floor.

The electrically conductive member may consist entirely of electrically conductive material but preferably comprises a strip or tape incorporating a plurality of filaments formed from or coated with electrically conductive material. The member may advantageously be formed from woven polyester fabric incorporating electrically conductive yarns. In a typical construction the electrically conducting fibres in the fabric from which the articles are constructed are arranged to form a 5mm grid pattern, the electrically conducting fibres in the electrically conducting member being arranged in parallel lines approximately 2mm apart.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:-

Fig. 1 is an illustration of an article of workwear incorporating one embodiment of the invention;

Fig. 2 is a perspective view showing the manner of interconnection of adjacent panels of the garment shown in Fig. 1;

Fig. 3 is an enlarged cross-section through the seam formed between the adjacent panels shown in Figs. 1 and 2;

Fig. 4 is an illustration of fabric and tape constructions incorporated in the embodiment of Figs. 1 to 3;

Figs. 5 and 6 show alternative means of interconnecting the components of a garment similar to that shown in Fig. 1;

Fig. 7 shows a means of electrically interconnecting a sleeve and cuff of a

similar garment;

Fig. 8 illustrates a method of interconnecting a garment and articles of footwear according to a further embodiment of the invention;

Fig. 9 is an enlarged fragmentary side view of part of the embodiment shown in Fig. 8;

Fig. 10 shows a further method of interconnecting a garment with a hood and with articles of footwear;

Fig. 11 is an enlarged cross-section showing the manner of interconnection in the arrangement of Fig. 10; and

Fig. 12 is a side view of the arrangement shown in Fig. 10.

Referring to Figs. 1-3, there is shown an article of workwear in the form of an overall comprising four components, namely a main body component 10, first and second arm components 11 and a trouser or lower body component 12 comprising two leg portions 13. Each of the components is constructed from a woven cleanroom fabric such as continuous filament polyester and incorporates a grid of electrically conductive fibres generally constructed from polyester and carbon and typically spaced apart by intervals of 5mm or more. This electrically conductive grid forms a path for localised electrical static charge to be dissipated across the conductive grid.

The body panel 10 is connected to the arm panels 11 by seams 15 and to the lower body or leg portion 12 by a seam 16. In order to ensure electrical continuity between the panels across the seams 15 and 16, each of the seams incorporates a strip or tape of electrically conductive material as best seen in Figs. 2 and 3. For this purpose the edge regions of each panel are folded into generally hook or U-shaped configuration and engaged with one another as shown in Fig. 2 and 3 so that two layers 17A, 17B of one panel and two layers

18A,18B of the adjacent panel overlap one another. A strip or tape 20 of electrically conductive material is located between adjacent portions 17A and 18B of the overlapping panels and the assembly secured together by lines of stitching indicated diagrammatically at 19A and 19B. The strip or tape 20 of electrically conducting material is thus clamped between the overlapping portions of the two panels and extends longitudinally for the full length of the associated seam 15 or 16.

The strip 20 is formed from polyester fabric incorporating a plurality of electrically conductive yarns 22 formed, for example, from carbon coated nylon or conductive polyester yarns. The conductive yarns are woven through the strip and come frequently to the surface where they are bent around the yarns forming the strip or tape itself and thus project from the surface of the tape, typically by 0.5-1.0mm. In this way the projecting yarns are pressed into contact with the conductive yarns of the grid 21, thereby enhancing the electrical contact between them.

Fig. 4 shows a typical garment fabric 10 and tape 20 to scale, the electrically conductive yarns 21 in the fabric forming a grid of 5mm mesh size compared with a 2mm spacing of the electrically conductive yarns 22 of the tape 20. The yarns 22 are exposed at the surface of the tape at the zones 22A indicated by heavy lines in Fig. 4. The yarns 22 are also of larger diameter than the yarns 21, generally being of the order of 0.5-1.0mm in diameter compared with 0.01-0.05mm diameter for the yarns 21. By virtue of the close spacing of the yarns 22 compared with the grid size of the yarns 21 and the relatively high degree of exposure of the yarns 22 at the surface of the tape 20, the yarns 22 make contact with a high proportion of the fibres 21 in the overlapping portions 17A,18B of the adjacent panels of the garment and provide an effective electrical connection between them. This enables the garment to be earthed from a single point since the electrical continuity which exists in the individual panels by virtue of the electrically conducting fibres 21 woven into the material, is continued across the seams 15 and 16 by virtue of the electrically conductive tape incorporated in the seams.

Fig. 5 of the drawing shows an alternative arrangement in which electrical continuity between body panels 10,11 and 12 of a garment is maintained across interconnecting seams 15 and 16 by short lengths of electrically conductive tape similar to the tape 20 described with reference to Figs. 1 to 4. In this embodiment short sections of tape 20 are arranged to bridge the seams 15 and 16, each section being connected at its opposite ends by sewing or other suitable means to the respective panels 10,11 or 10,12. In this way the loss of electrical continuity across the seams is compensated by the electrical "bridges" formed by the sections 20 of tape. The number of sections of tape employed may be varied dependent on the spacing of the electrically conducting grid in the fabric, the length of the seams and the measured electrical conductivity across the seams.

Fig. 6 of the drawings shows an alternative means of improving electrical conductivity across seams of a unitary garment in which electrically conductive tape 20 of similar construction to that described with reference to Figs. 1 to 4 is sewn to the surface of the garment and extends across the panels from which the garment is constructed. In the embodiment shown in Fig. 6 a first length of tape 20A extends from one arm portion 11 across the main body panel 10 to the other arm portion 11, thereby bridging the seams 15 formed between the body portion 10 and the two arm portions. A second length of electrically conductive tape 20B extends across the body portion 10 and down one leg 13 of the lower body portion 12. The strip 20B intersects and is secured to the strip 20A adjacent the upper region of the body portion 10 and thereby provides electrical continuity between the arm components 11, the body portion 10 and the leg portion 12 of the garment. Fig. 6 also shows an extension 20C of the strip 20B connected to an integral hood portion 23 of the garment connected to the body portion 10 by a seam 24. In this way electrical continuity is maintained between all the panels making up the garment thereby enabling it to be earthed from a single point.

Fig. 7 shows an embodiment of the invention employed to establish electrical connection between a sleeve 11 constructed from fabric incorporating

electrically conducting fibres 21 as previously described, and a cuff 11A. Generally such cuffs are formed from electrically conductive knitted yarns and serve to ensure close contact between the garment and the wearer's skin. In the arrangement shown in Fig. 7 electrically conductive tape 20 similar to that described above is sewn onto the sleeve 11 and projects beyond the end of the sleeve over the cuff 11A. The tape 20 is connected to a component 25 of a metallic stud-type fastener secured to the cuff 11A and adapted to form a terminal by means of which the garment can be connected to earth. The tape 20 bridges the seam 26 between the sleeve 11 and the cuff 11A thereby maintaining electrical conductivity from the sleeve to the cuff in the manner previously described. The electrical connection between the stud 25, tape 20 and cuff 11A may be enhanced, if desired, by attachment of a section 27 of the fabric from which the arm and remainder of the garment is constructed around the area of the stud 25. The tape 20 may be relatively short in length as illustrated in Fig. 7 serving simply to bridge the seam 26. Alternatively the tape 20 may comprise a terminal portion of a tape which extends to other parts of the garment in the manner illustrated, for example, in Fig. 6.

Figs. 8 and 9 of the drawings show an alternative arrangement in which electrical continuity is maintained between a one piece garment indicated at 30 and a separate article of footwear (not shown). As shown in the drawing the garment 30 is of integral one piece construction comprising a hood 31 and a body portion 32 incorporating integral arm portions 33 and integral leg portions 34. The garment is constructed from a cleanroom fabric incorporating electrically conductive fibres in the manner previously described and electrical continuity is therefore maintained throughout the garment by virtue of the conductive fibres incorporated in its construction. A stirrup 35 is fitted to the lower end of each leg of the garment and is formed from similar electrically conductive cleanroom fabric incorporating a grid of conductive fibres. The stirrup is connected at each of its ends to the lower edge of the associated leg portion 34 of the garment and is adapted in use to extend under the user's foot 36 and inside a separate article of footwear (not shown).

In order to enhance electrical conductivity between the garment and the stirrup, a strip 37 of electrically conductive material similar to that described with reference to the previous embodiments is sewn into the stirrup 35 and projects at opposite ends where it is sewn to the lower region of the leg portion 34. In this way the electrically conductive tape bridges the seams between the stirrup and the associated leg portion and maintains electrical continuity between the conductive grids incorporated in the fabrics from which both components are formed. A stud 38 may be provided on the stirrup 35 for connection of an ankle earth if required.

The articles of footwear worn by operatives are conventionally provided with electrically conductive soles whereby the operative is earthed to the floor. By virtue of the arrangement described with reference to Figs. 8 and 9, the operative's garment is earthed through the conductive sole by virtue of the electrically conductive tape 37 which connects with the main body of the garment and the stirrup and thereby enables the entire garment to be earthed from the stirrups fitted to each of the leg portions of the garment.

While in the arrangement shown in Figs. 8 and 9 the garment is illustrated as being of integral construction, in practice it will normally comprise separate components interconnected by seams in the manner described with reference to Figs. 1 to 6. In that event the panels from which the garment is constructed are preferably interconnected by electrically conductive strip or tape material in the manner described with reference to these figures, thereby ensuring electrical continuity is maintained across the seams. Alternatively the workwear may comprise separate hood, body and leg components in which event these are preferably interconnected using electrically conductive tape and suitable fasteners in the manner to be described with reference to Figs. 10 to 12 of the drawings to maintain electrical continuity between the separate garments or components making up the overall article of workwear.

Referring now to Figs. 10 to 12, there is shown a means of maintaining

electrical continuity between separate garments which together form a complete article of workwear. In the embodiment shown in Figs. 10 to 12 the complete article of workwear comprises an integral body portion 40 incorporating arm and leg portions 41 and 42, a separate hood portion 43 and separate shoes or boots 44 adapted to be fitted over the lower portions of the legs 42. The hood portion 43 is adapted to overlies the upper region of the body portion 40. At the area where the two components overlap, short sections of electrically conductive tape 20 similar to that described with reference to Figs. 1 to 4 are sewn into the lower edge region of the hood 43 and the neck region of the body portion 40 respectively. Each section of tape is fitted with a respective component of a stud or other suitable fastener 45 which engages the conductive tape which in turn is in contact with the grid of electrically conductive fibres woven into the fabric from which the articles are made. Each component of the stud fastener is therefore electrically connected to the associated garment and when the garments are fitted and the stud fasteners interconnected, electrical continuity is effected between the separate garments.

The boots 44 are connected to the leg portions 42 of the garment in a similar fashion. As shown in Figs. 11 and 12, a strip 46 of electrically conductive tape similar to that described with reference to Figs. 1 to 4 is sewn into an upper region of each boot 44 and a similar strip 47 of tape is sewn on to the adjacent lower region of each leg portion 42. Each section of tape bridges a number of the fibres forming the conductive grid in the fabric from which the boot and body portion are formed and respective components 48A, 48B of a stud fastener are fitted to the tape connected to each article. When the boot is fitted over the lower end of the leg, the respective components of the stud fastener are engaged thereby forming electrical continuity between the shoe or boot and the garment as a whole.

Although not shown in Fig. 10, the arm, body and leg portions of the garment are preferably electrically interconnected across the seams between them by any of the means shown in Figs. 1, 5 or 6 of the drawings.

By virtue of the arrangements described electrical continuity may be maintained across seams of a single article or between separate components forming a complete article of workwear. This enables the workwear to be earthed from a single point, such as from a cuff or ankle or through an article of footwear in the manner described with reference to Figs. 7 to 12 of the drawings. The arrangements described are also of simple construction yet provide an effective means of maintaining electrical continuity throughout workwear consisting of multiple interconnected panels and/or multiple separate garments, thereby enabling static electrical charges to be dissipated without requiring complex multiple earthing arrangements. The construction of the tape is also such that it will withstand repeated exposure to commercial laundering cycles without loss of electrical conductivity.

Various modifications may be made without departing from the invention. For example the invention may be applied to a wide range of workwear garments consisting of multiple separate articles or incorporating seams in a variety of different locations. The fabric from which the garments is constructed may vary as regards its material and the nature and extent of the electrically conductive fibres incorporated in it. For example while such fibres are normally incorporated in a grid formation, they may alternatively be incorporated in the form of stripes. The electrically conducting strip or tape employed in the embodiments may be constructed in a wide variety of alternative forms provided it has a substantial electrically conductive surface area adapted to bridge a plurality of the conductive fibres incorporated in the fabric from which the components of the garment are constructed to thereby maintain electrical continuity throughout the workwear article. The tape may also be secured to the inside or outside surfaces of the components by sewing or other suitable means.

Moreover while reference has been made herein primarily to effecting electrical continuity between components of articles of workwear, the invention may also be applied to other situations where it is necessary to maintain electrical continuity across seams, joins or other areas where a break in

electrical continuity would otherwise occur.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

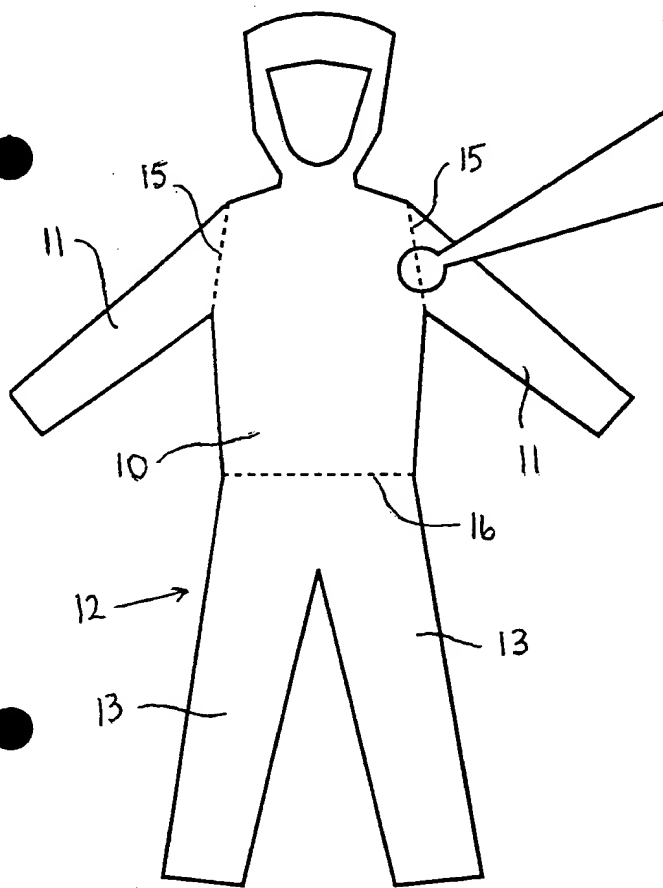


FIG. 1

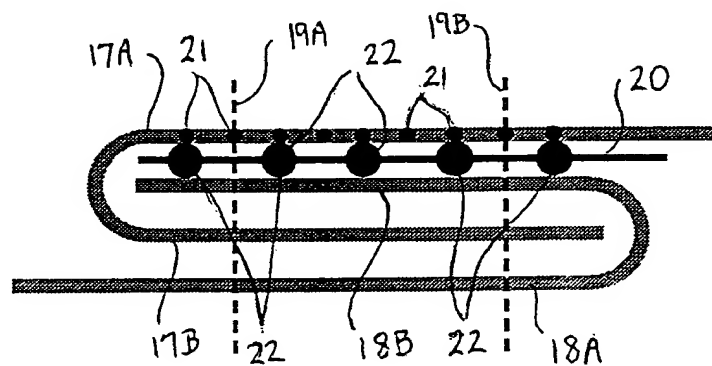


FIG. 3

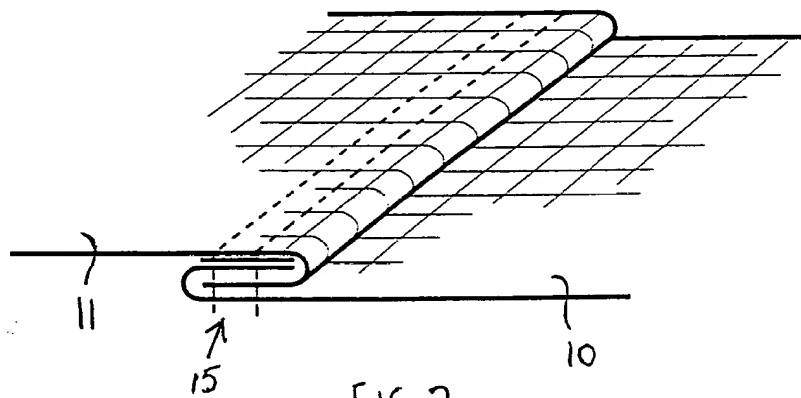


FIG. 2



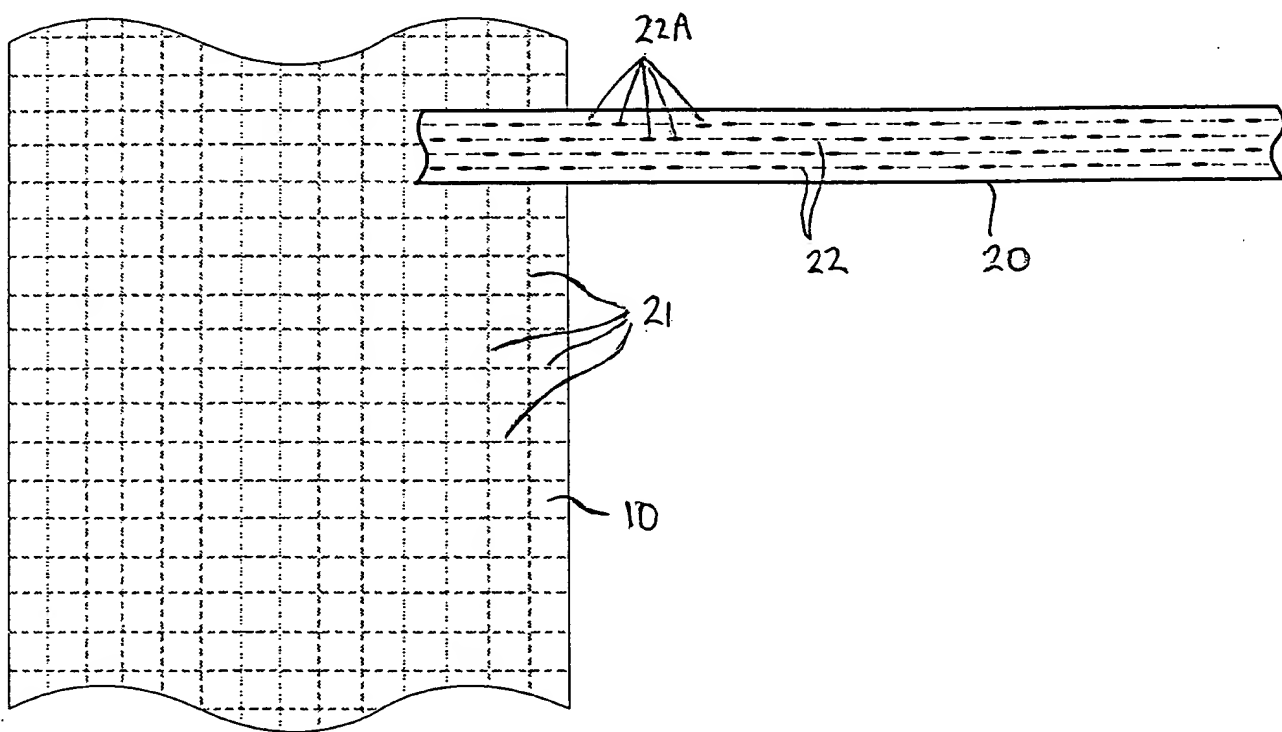
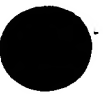


FIG. 4



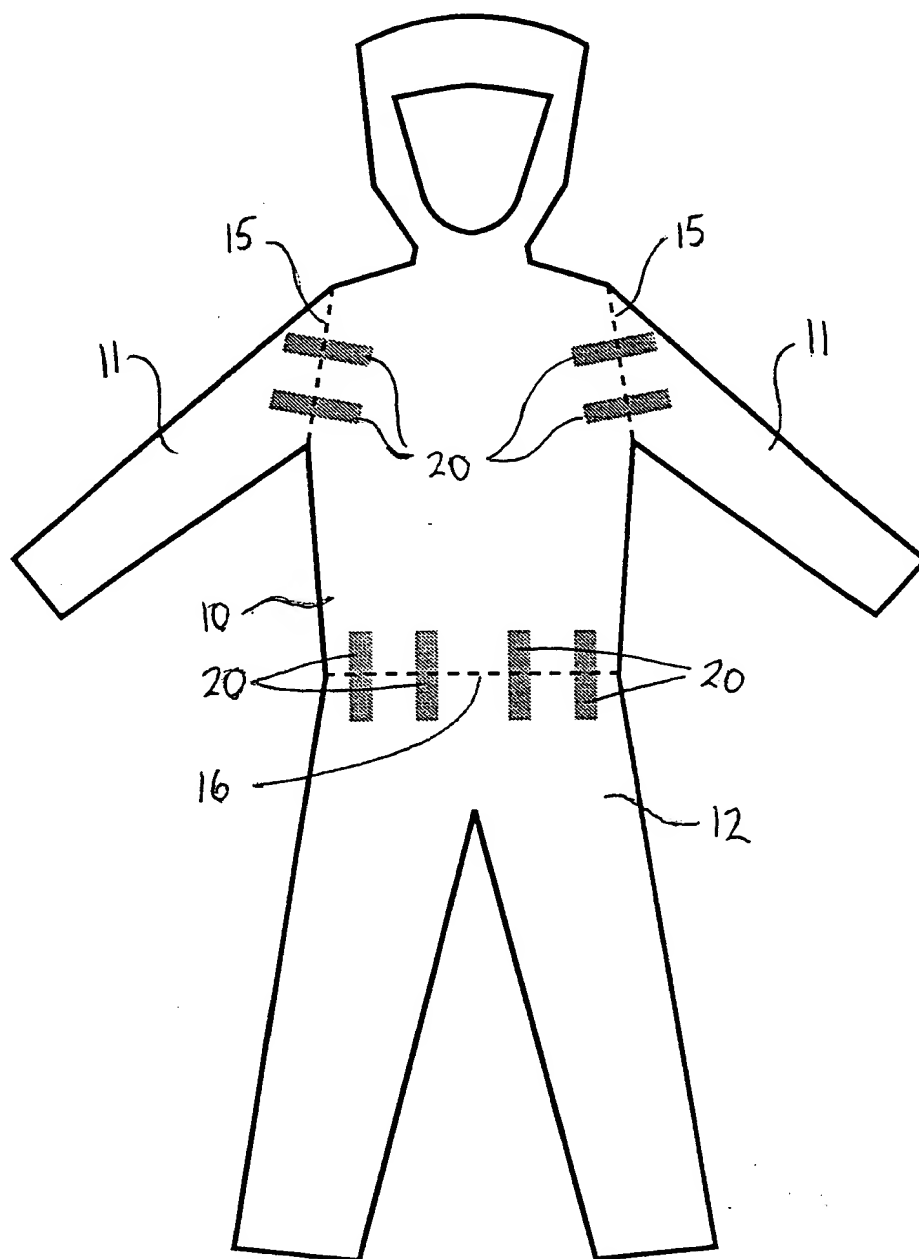


FIG. 5



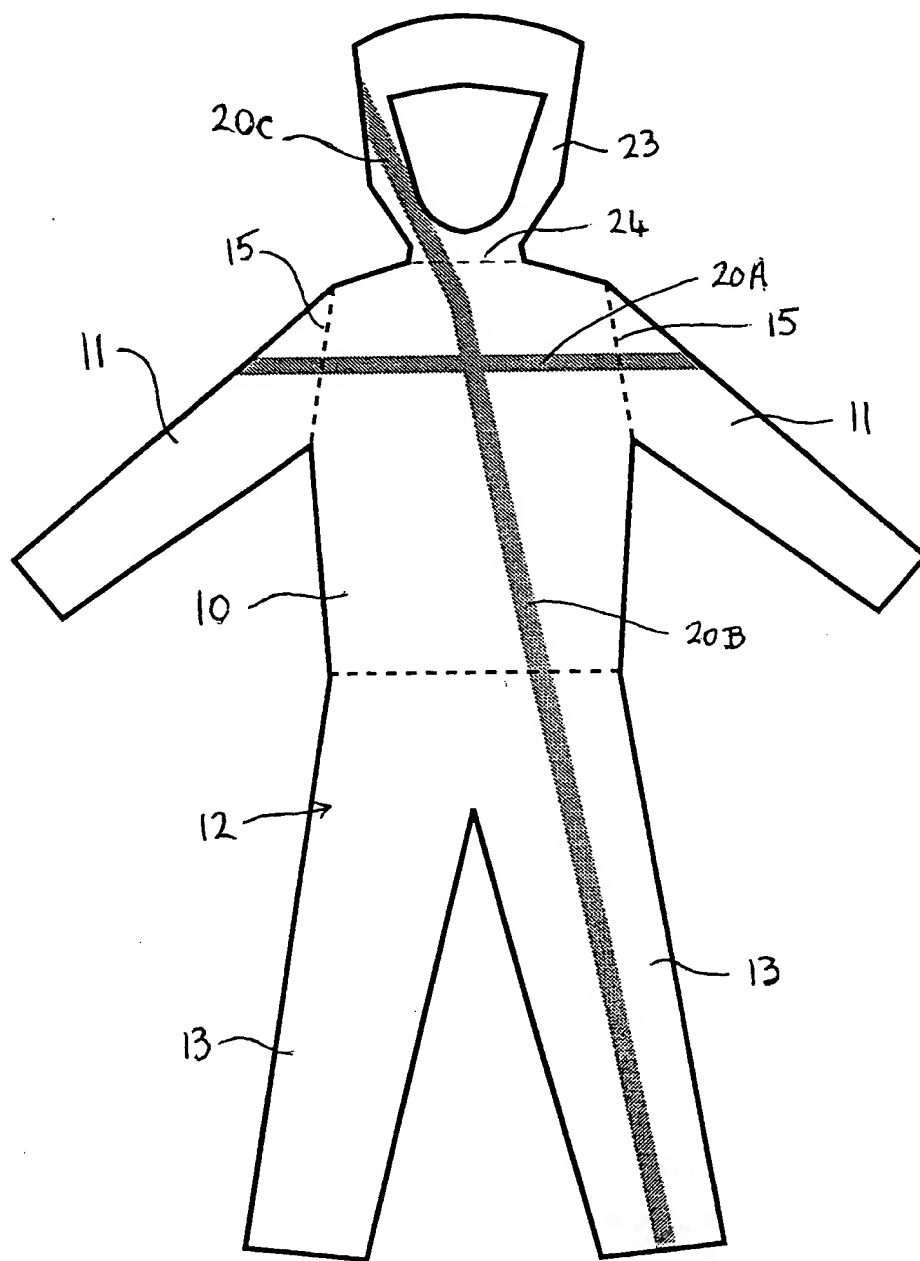


FIG. 6



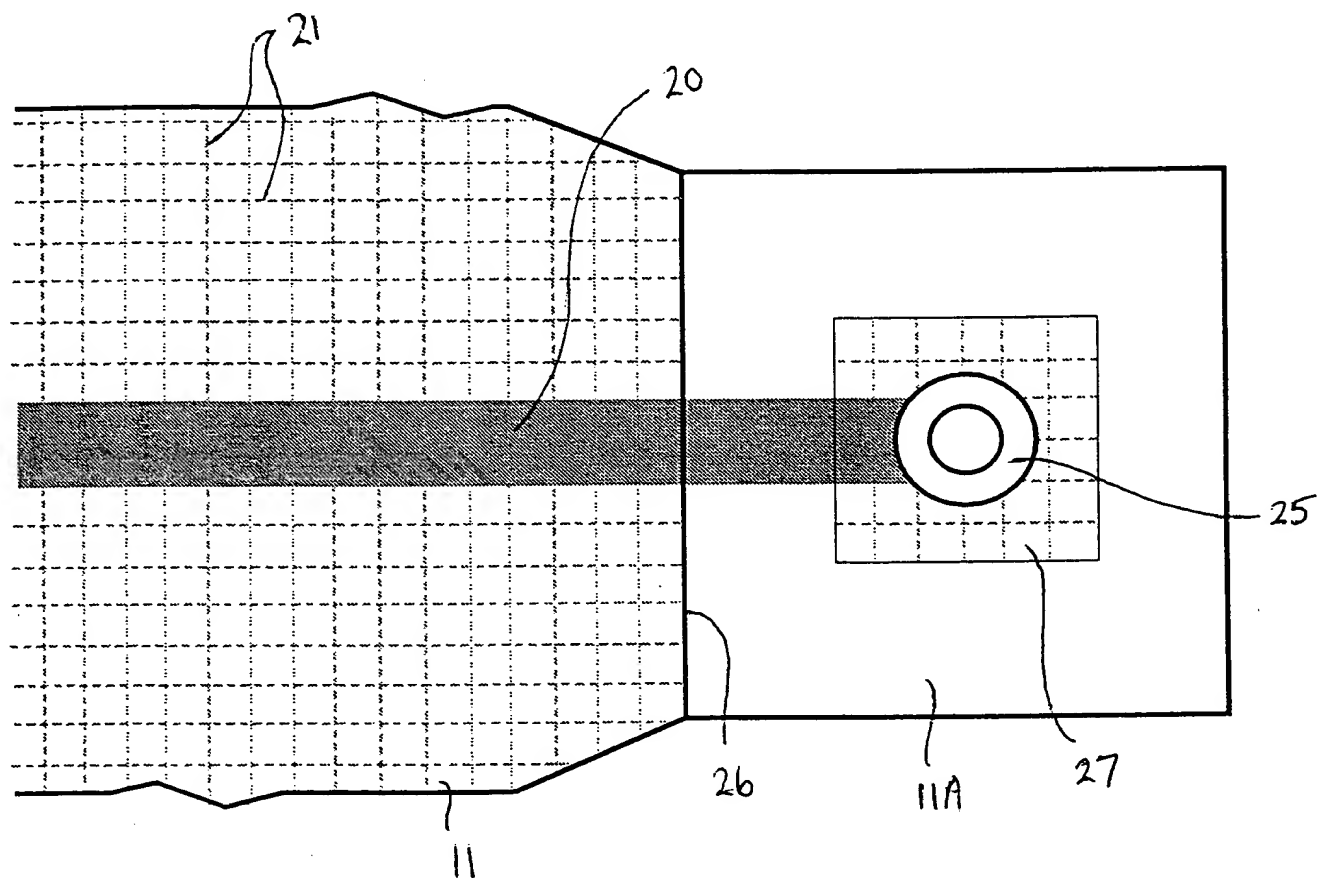


FIG. 7



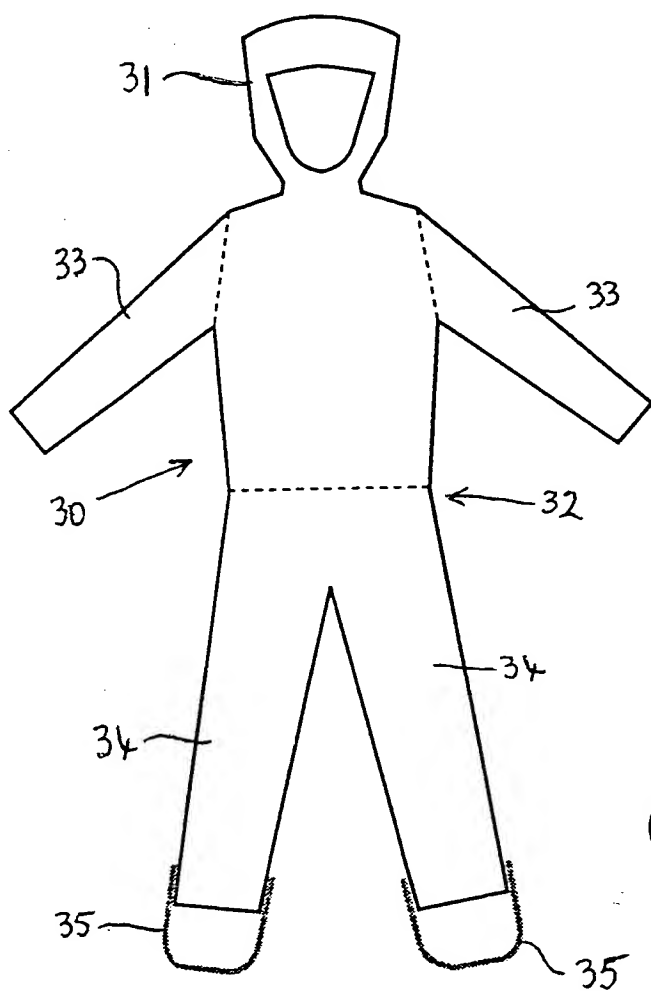


FIG. 8

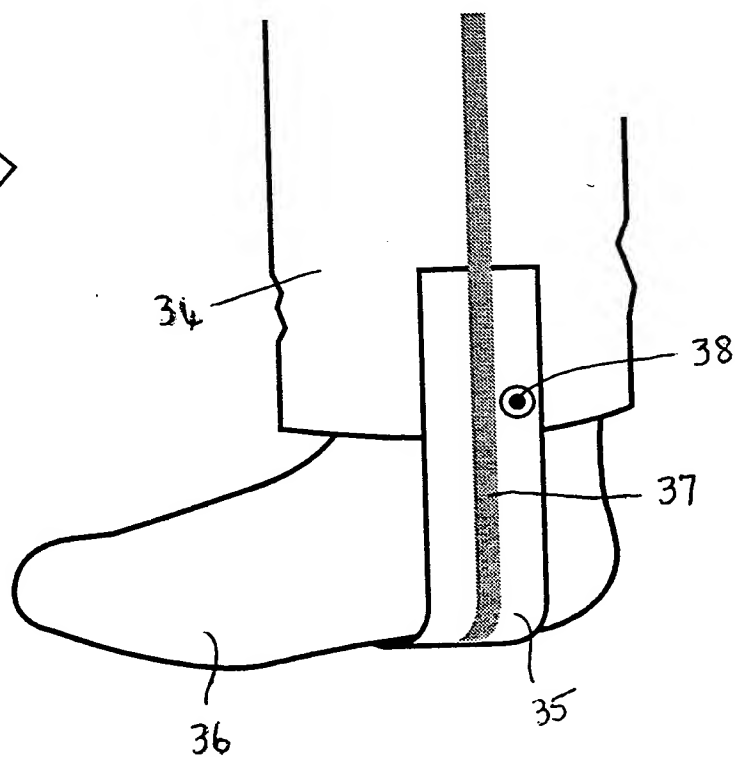


FIG. 9

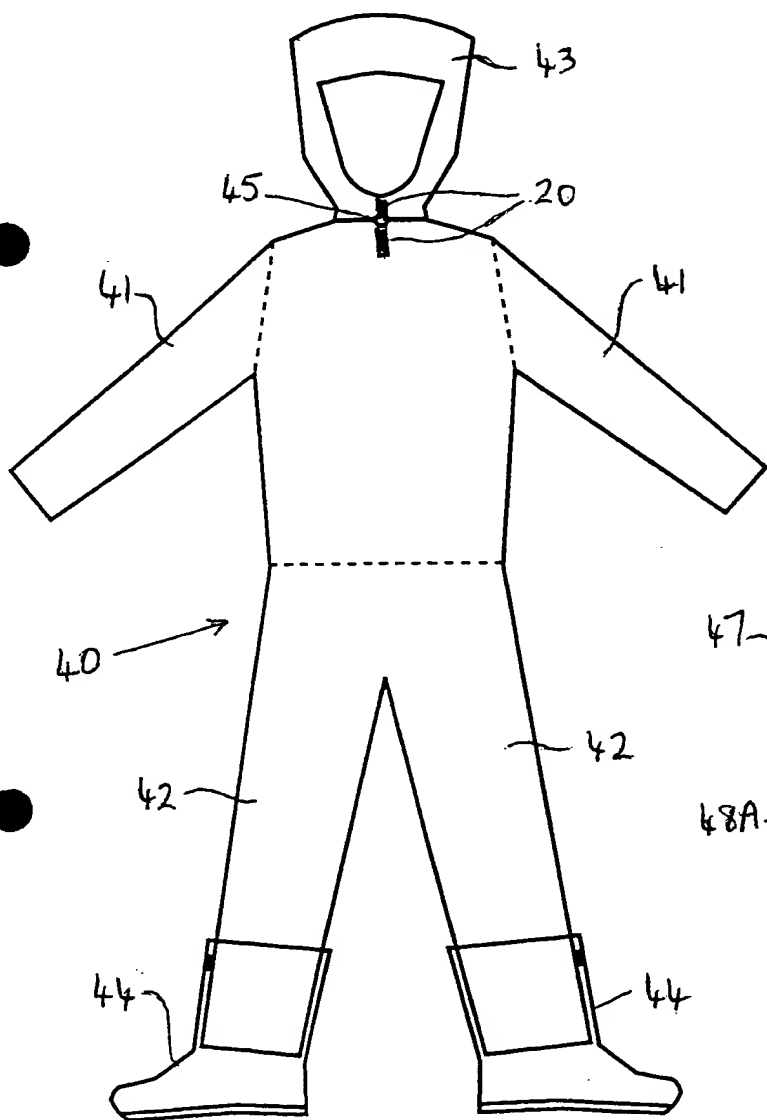


FIG. 10

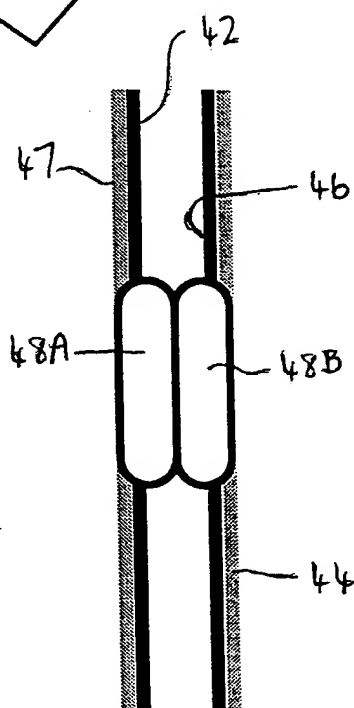


FIG. 11

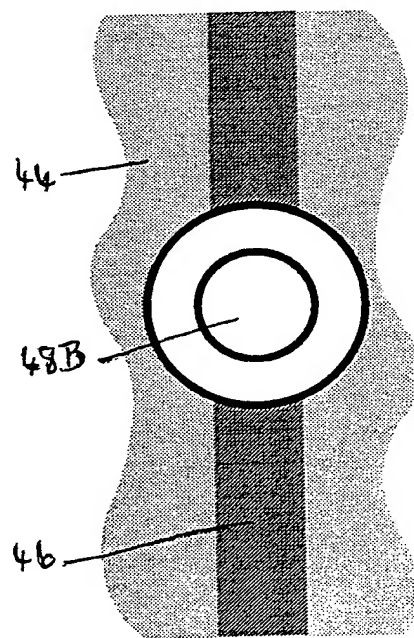


FIG. 12

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